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New species and new records of *Diorygma* (*Graphidaceae*) from India: species with convergent exciples

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Abstract — Nine species of the lichen genus *Diorygma* with convergent exciples are recognized from India, of which six species are new to science viz. *D. albocinerascens*, *D. albovirescens*, *D. excipuloconvergentum*, *D. megaspermum*, *D. megistosporum*, and *D. panchganiense*. Two other species, *Diorygma "microsporum"*, and *D. "patwardhanii"*, clearly distinguished from the other species, are recorded, but are not formally described as new to science as the material is scanty. Additional specimens of *D. megasporum* are reported from India.

Key words — ascomycetes, taxonomy, *Ostropales*

Introduction

The lichen genus *Diorygma* is characterized by an inconspicuous pseudocortex, which results in a matte, often granular, farinose upper surface; lirellate ascocarps with a heavily pruinose disc; branched, anastomosing paraphyses with a thick gelatinous wall (usually only the lumina are distinctly visible); paraphysis tips that are reticulately interwoven to form an epithecium; asci of the *Graphis*-type; ascospores hyaline, very rarely brownish, transversely septate with lenticular spore locules or muriform, and the presence of norstictic, stictic and/or protocetraric acid chemosyndromes (Kalb et al. 2004).

Diorygma Eschw., a widely distributed, tropical to subtropical lichen genus with twenty-four species at the world level, was reintroduced by Staiger (2002) and monographed by Kalb et al. (2004). Subsequently, three species from Australia (Archer 2006, Archer & Elix 2008), one species from the Solomon Islands (Archer 2007), one species from Brazil (Cáceres 2007), and four species from India (Sharma & Makhija 2009) have been described in this genus.

The genus *Diorygma* in India was known from five species (Kalb et al. 2004)—*D. hieroglyphicum* (Pers.) Staiger & Kalb, *D. junghuhnii* (Mont. & Bosch) Kalb et al., *D. megasporum*, *D. pruinosum* (Eschw.) Kalb et al. and *D. tuberculosum* (Stirt.) Kalb et al.

In our previous studies on *Diorygma* from India four new species of the genus *Diorygma* with norstictic and salazinic acid as major compounds, namely *D. dealbatum* B.O. Sharma & Makhija, *D. inaequale* B.O. Sharma & Makhija, *D. manipurense* B.O. Sharma & Makhija and *D. verrucirimosum* B.O. Sharma & Makhija were described (Sharma & Makhija 2009).

In the present studies, nine species have been discovered with convergent lateral margins, very thick epihymenia and hyaline, muriform ascospores (Figs.1–3), all of which come close to the species *Diorygma megasporum* (which is also based on Indian material). In their monograph on the lichen genus *Diorygma*, Kalb et al. (2004), in describing their new species *D. megasporum,* clearly stated that, "the ascocarp morphology differs from other species of the genus by their slightly convergent lateral margins and a very thick epihymenium. It is possible that this species would be better accommodated in another, as yet undescribed genus, but molecular data should be sought to clarify this possibility."

The nine species described below have been placed in the genus *Diorygma* but they may prove to be species of the new undescribed genus referred to above.

Materials & methods

Sections of ascocarps were mounted in water, 10% KOH (K), and lactophenol. The hymenium was stained with Lugol's solution without and with pretreatment of KOH (I and KI). All measurements were made on material mounted in water. Chemical data was obtained by the standard method of TLC (Culberson & Kristinsson 1970, White & James 1985) using solvent systems benzene-dioxane-acetic acid (180:45:5), hexane-ethyl ether-formic acid (130:80:20) and toluene-ethyl acetate-formic acid (139:83:8). The specimens have been deposited in the Ajrekar Mycological Herbarium (AMH).

Taxonomy

Key to species with convergent exciples from India

1a. Asci 1–2-spored **2**

1b. Asci more than 2-spored **5**

2a. Ascospores exceeding 200 µm in length (ascocarps 0.5–9 mm long and 0.1–0.25 mm broad; ascospores 231–244 × 59–76 µm; consalazinic, constictic, cryptostictic and stictic acids present) . . . . . ***D. megaspermum***

2b. Ascospores not exceeding 200 µm in length **3**

3a. Ascospores exceeding 100 µm in length (ascocarps 0.5–6 mm long and 0.2–1 mm broad; ascospores 135–150 × 18–27 µm; cryptostictic, methylstictic, norstictic, and salazinic acids present) . . . . . ***D. albocinerascens***

3b. Ascospores not exceeding 100 µm in length **4**

4a. Ascocarps 1–2 mm long and 0.5–1.3 mm broad; ascospores 1–2/ascus, 75–99 × 24–30 µm; norstictic, salazinic and methylstictic acids present . . . . . ***D. panchganiense***

4b. Ascocarps 1–1.5 mm long and 0.2–0.5 mm broad; ascospores 1/ascus, 57–96 × 24–36 µm; consalazinic, constictic, cryptostictic, hypostictic, norstictic, and stictic acids present. . . . . ***D. "patwardhanii"***

5a. Ascospores exceeding 200 µm in length; norstictic acid present . . . . . **.6**

5b. Ascospores not exceeding 200 µm in length; norstictic acid absent 7

6a. Ascocarps whitish to pale, 1–4 mm long and 0.1–0.3 mm broad; ascospores 1–4 /ascus, 151–294 × 38–63(–84) µm; cryptostictic, norstictic and stictic acids present. . . . . ***D. megistosporum***

6b. Ascocarps 1–6 mm long and 0.1–0.25 mm broad; ascospores 1–2–4/ascus, 147–273 × 34–67 µm; constictic, cryptostictic, methylstictic, norstictic, and salazinic acids present . . . . . ***D. excipuloconvergentum***

7a. Ascospores exceeding 100 µm in length (ascospores 1–8/ascus, 85–197 × 29–71 µm; constictic, stictic, and cryptostictic acids present) . . . ***D. megasporum***

7b. Ascospores not exceeding 100 µm in length . . . . . **.8**

8a. Ascocarps 3–7 mm long and 0.1–0.25 mm broad; ascospores 8/ascus, 46–63 × 17–25 µm; stictic acid present . . . . . ***D. "microsporum"***

8b. Ascocarps 0.5–3 mm long and 0.2–0.5 mm broad; ascospores 4–8/ascus, 66–99 × 12–36 µm; constictic, cryptostictic and stictic acids present . . . . . ***D. albovirescens***

New Species

Diorygma albocinerascens Makhija, Chitale & B.O. Sharma, **sp. nov.** FIGURE 4

MYCOBANK MB 513536

Similis Diorygma megasporum, *sed acida cryptosticticum, methylsticticum, norsticticum et salazinicum continens differt.*

ETYMOLOGY: From the Latin *albo*, white and *cinereus*, grey white; a reference to the colour of the thallus.

Holotypus—India, Maharashtra, Sindhudurg District, on the way to Phonda, 12.10.2000, *U.V. Makhija & B.C. Behera*, 00.263: AMH.

THALLUS crustose, corticolous, whitish gray, epiphloeodal, continuous, smooth to rough, finely cracked, pseudocortex not visible, hypothallus black. ASCOCARPS lirelline, 0.5–6 mm long and 0.2–1 mm broad, simple, furcate, dendroidly branched, immersed, straight or curved, concolorous with the thallus, with obtuse ends; thalline margin slightly raised, concolorous or paler than the thallus, entire, studded with crystals, encircling exciple; disc narrow, slit-like, light brown, slightly pruinose; exciple convergent, poorly developed, 2–3-striate, present at the base, thin, pale brown, blackish brown at apices, covered by a thick, thalline margin up to the top; epihymenium dark blackish brown

to almost black, 15–21 µm thick, covered by fine pruina; hymenium hyaline, not inspersed, 126–215 µm tall, KI+ blue; paraphyses branched, interwoven, thickened, compact at apices; asci 1–2-spored. Ascospores hyaline, muriform, ellipsoid, peripheral and central spore locules of equal size, 135–150 × 18–27 µm, I+ violet.

Chemistry—Cryptostictic, methylstictic, norstictic, and salazinic acids (major).

Additional specimens examined—**Maharashtra**, **Kolhapur District**, Panhala, *P.G. Patwardhan & C.R. Kulkarni*, 74.1079; *G.S. Chitale*, 02.283. **Pune District**, Amby valley, 26 km ahead of Lonavala, *B.A. Adawadkar & B.C. Behera*, 03.206, 03.207; *B.A. Adawadkar & G.S. Chitale*, 03.191; *B.A. Adawadkar & N. Verma*, 03.246; *G.S. Chitale & B.A. Adawadkar*, 03.253, 03.259; *U.V. Makhija*, 06.105; Purandar fort, *P.D. Badhe*, 71.38; Durgwadi, *U.V. Makhija*, 04.146; Durgawadi, Junnar, *U.V. Makhija & A.V. Dube*, 03.296; Deoghar, Lonavala, *U.V. Makhija*, 06.139, 06.142, 06.143; Khandala, *B.A. Adawadkar & G.S. Chitale*, 03.199.**Ratnagiri District**, Chiplun, *G.S. Chitale*, 04.78; *G.S. Chitale*, 07.12, 07.13. **Satara District**, Table Land, Panchgani, *N. Verma*, 06.221, 06.222, 06.224; Wilson Point, Mahabaleshwar, *P.G. Patwardhan & M.B. Nagarkar*, 85.2938; Near Arther Seat Point, *M.B. Nagarkar & A. V. Prabhu*, 74.1724; Ambenali ghat, Mahabaleshwar, *G.S.* Chitale, 06.195. **Sindhudurg District**, Amboli, *C.R. Kulkarni & A.V. Prabhu*, 74.1444. **Thane District**, Malshej Ghat, Neemgiri, *B.C. Behera & U.V. Makhija*, 02.34. On the way to Phonda from Radhanagari, *U.V. Makhija & K.R. Randive*, 00.281: AMH

Remarks—With convergent lateral margins and a very thick epihymenium, *Diorygma albocinerascens* closely resembles *Diorygma megasporum*. The spore dimensions in each species are similar: *D. megasporum* 80–170(–220) × 21–55 µm compared to *D. albocinerascens* 135–150 × (12–)18–27 µm. However the two species differ in their chemistry: *D. megasporum* has constictic, stictic, and α-acetylconstictic acids according to Kalb et al. (2004) while the new species has cryptostictic, methylstictic, norstictic, and salazinic acids. It differs in lacking the stictic acid present in *D. megasporum*.

Diorygma albovirescens Makhija, Chitale & B.O. Sharma, **sp. nov.** Figure 5

MycoBank MB 513537

Similis Diorygma intermedium, *sed acida constictum, cryptosticticum et sticticum continens et excipulum convergentum differt.*

Etymology: From the Latin *albo*, white and *virescens*, greenish a reference to colour of the thallus.

Holotypus—India, Maharashtra, Ratnagiri District, Chiplun, 15.5.2004, *G.S. Chitale*, 04.80: AMH.

Thallus crustose, corticolous, greenish white, epiphloeodal, continuous, smooth to cracked, pseudocortex indistinct, hypothallus indistinct. Ascocarps lirelline, 0.5–3 mm long and 0.2–0.5 mm broad, simple to branched, flexuous, immersed to semi-emergent, concolorous with the thallus, fissure like; thalline margin raised and often separated from the thallus or the disc by a

deep slit, concolorous or paler than the thallus, entire, studded with crystals, encircling exciple; disc narrow, slit-like, blackish brown, covered with white pruina; exciple poorly developed, 2–3-striate, present at base, thin, pale brown to blackish-brown at apices, convergent, covered by a thick, thalline margin up to the top; epihymenium dark, blackish brown to almost black, 34–42 µm thick; hymenium hyaline, not inspersed, 126–250 µm tall, KI+ blue; paraphyses branched, thickened, interwoven, compact at apices; asci 4–8-spored. Ascospores hyaline, muriform, ellipsoid, peripheral and central spore locules of equal size, 66–99 × 12–36 µm, I+ violet.

Chemistry—Constictic, cryptostictic, and stictic acids (major).

Additional specimens examined—**Maharashtra**, **Ratnagiri District**, Chiplun, *G.S. Chitale*, 04.77, 04.81, 04.84, 04.85, 04.88, 04.90. **Satara District**, Mahabaleshwar, Lingmala, *B.A. Adawadkar*, 04.14. **Sindhudurg District,** on the way to Vaibhavwadi, *B.A. Adawadkar & K.R. Randive*, 00.373: AMH

Remarks—*Diorygma albovirescens* resembles *D. intermedium* Kalb et al.: both have long ± flexuous, branched ascocarps, appearing as fissures, immersed in the thallus, a whitish disc surrounded by a thalline margin often distinctly raised and separated from the thallus by a deep slit. However, the chemistry of the species differ: *D. intermedium* has hypostictic acid and derivatives (hypostictic, hypoconstictic, and α-acetylhypoconstictic acids) whereas *D. albovirescens* has stictic acid derivatives (constictic, cryptostictic, and stictic acids). The two species also differ in distribution. *Diorygma intermedium* has a neotropical distribution in contrast to *D. albovirescens* which is so far known only from India.

Diorygma excipuloconvergentum Makhija, Chitale & B.O. Sharma, **sp. nov.**

MycoBank MB 513538 Figure 1–3, 6

Similis Diorygma megasporum*, sed ascosporis majoribus et acida constictum, cryptostictum, methylstictum, norstictum et salazinicum continens differt.*

Etymology:From the Latin *excipulo*, exciple and *convergens*, convergent, a reference to convergent exciple.

Holotypus—India, Maharashtra, Pune District, Purandar Fort, 13.9.2002, *U.V. Makhija & A.V. Bhosale*, 02.60: AMH.

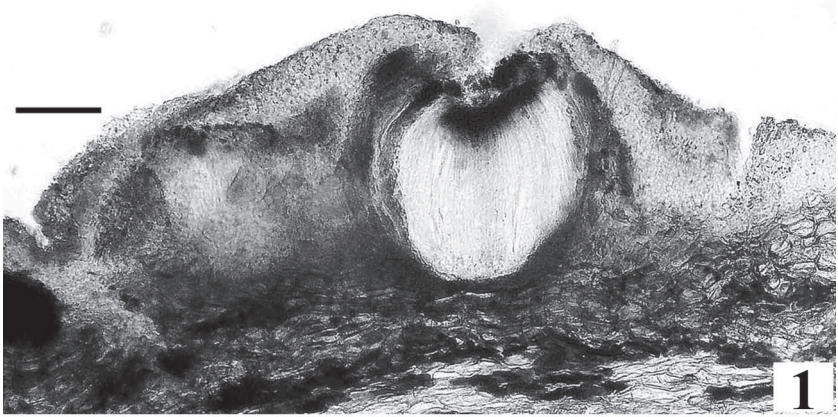
Thallus crustose, corticolous, epiphloeodal, continuous, smooth to cracked, sometimes uneven, pale glaucous green to olivaceous buff or whitish, pseudocortex indistinct, hypothallus black. Ascocarps lirelline, 1–6 mm long and 0.1–0.25 mm broad, simple to rarely branched, immersed to semi-emergent, concolorous with the thallus, with obtuse ends; thalline margin raised, overarching the exciple, studded with crystals; disc white, narrow, slit-like, later moderately open, white pruinose; exciple poorly developed, pale yellow, indistinctly 2–4-striate, blackish brown at apices, present at the base,

converging at the apical portion; epihymenium hyaline to blackish brown, 21–50 µm thick; hymenium hyaline, not inspersed, 105–185 µm tall, lateral and upper part KI+ blue; paraphyses branched, long, thin, septate, branched at apices; asci 1–2(–4)-spored. Ascospores hyaline, muriform, ellipsoid, oblong, peripheral and central spore locules of equal size, 147–273 × 34–67 µm wide, I+ violet.

Chemistry—Constictic, cryptostictic, methylstictic, norstictic, and salazinic acids (major).

Additional specimens examined—**Maharashtra, Ahmednagar District**, Bhandardara, *G.S. Chitale* & *B.A. Adawadkar*, 02.161. **Kolhapur District**, Amba, *C.R. Kulkarni* & *A.V Prabhu*, 74.1249, 74.1250, 74.1259, 74.1262, 74.1269, 74.1329, 74.1369; Panhala, *P.G. Patwardhan* & *A.V. Prabhu*, 74.1055, 74.1056, 74.1057, 74.1059, 74.1062, 74.1064, 74.1065, 74.1066, 74.1067, 74.1068, 74.1073, 74.1074, 74.1082, 74.1084, 74.1086, 74.1092, 74.1096, 74.1098, 74.1099, 74.1100, 74.1104, 74.1107, 74.1110, 74.1111, 74.1115, 74.1116, 74.1123, 74.1124, 74.1126, 74.1127, 74.1131, 74.1185, 74.1443; *U.V. Makhija* & *B.C. Behera*, 00.277, 00.282; *B.A. Adawadkar* & *K.R. Randive*, 00.327; *B.C. Behera* & *V.A. Mantri*, 00.328; *U.V. Makhija* & *K.R. Randive*, 00.385, 00.386, 00.387, 00.394; *U.V. Makhija* & *G.S. Chitale*, 04.442; *B.C. Behera* & *N. Verma*, 04.438; Radhanagari guest house, *B.A. Adawadkar* & *K.R. Ranadive*, 00.377. **Nasik District**, Saptashringi Gad, *B.C. Behera* & *G.S. Chitale*, 02.183, 02.184a, 02.193, 02.233.**Pune District**, Bhimashankar, *U.V. Makhija*, 97.1, 97.2, 97.3, 97.16; Khandala, Boma Hills, *P.G. Patwardhan* & *M.B. Nagarkar*, 74.86, 74.630, 74.631, 74.633, 74.635, 74.637, 74.638, 74.639, 74.640, 74.641, 74.644, 74.645, 74.646, 74.647, 74.650, 74.651; *B.A. Adawadkar* & *K.R. Randive*, 00.89, 00.113; Purandar Fort, *B.A. Adawadkar* & *P.G. Patwardhan*, 93.14, 93.15, 93.24; *U.V. Makhija* & *A.V. Bhosale*, 02.53, 02.58, 02.59, 02.61, 02.62; Sinhagad Fort, *U.V. Makhija* & *B.A. Adawadkar*, 00.49, 00.50; Lonavala, Walwan dam, *B.C. Behera* & *B.A. Adawadkar*, 02.124, 02.125, 02.126, 02.128, 02.129; Lonawala, *G.S. Chitale*, 04.250; Malshej Ghat, Neemgiri, *U.V. Makhija* & *A.V. Bhosale*, 02.26, 02.27; Durgawadi, *U.V. Makhija* & *N. Verma*, 03.319; *G.S. Chitale*, 04.138; *B.C. Behera*, 04.139, 04.140, 04.141, 04.142, 04.143, 04.144; *U.V. Makhija*, 04.145, 04.147; *G.S. Chitale*, 04.157; Mulshi Dam, *P. Rao* & *G.S. Chitale*, 03.442, 03.447; Tamhini Ghat, *P. Rao* & *G.S. Chitale*, 03.443. **Raigad District**, Karnala, *G.S. Chitale* & *A.V. Bhosale*, 02.90; Warandha Bhor-Mahad, *C.R. Kulkarni*, 74.1946; *M.B. Nagarkar* & *A.V. Prabhu*, 74.1947, 74.1971; Hirdoshi, Bhor-Mahad, *M.B. Nagarkar*, 74.1976, 74.1977, 74.1978. **Ratnagari District**, Chiplun, *C.R. Kulkarni*, 02.271, G.S. Chitale, 04.76, 04.82, 04.83, 04.86; Kasheli Ghat, Poladpur, *C.R. Kulkarni*, 74.1935. **Satara District**, Ajinkyatara, *U.V. Makhija*, 04.104; Mahabaleshwar, *B.A. Adawadkar*, 97.58; Panchgani, *G.S. Chitale*, 01.39; *B.A. Adawadkar*, 01.45, *A.V. Bhosale*, 01.54; Lingmala, *G.S. Chitale*, 04.4, 04.5, 04.150; Panchgani, 04.6. **Sindhudurg District**, Amboli, *C.R. Kulkarni*, 74.1390; *C.R. Kulkarni*, 74.2296, 74.2329; Amboli, *P.G. Patwardhan* & *C.R. Kulkarni*; *U.V. Makhija* & *B.A. Adawadkar*, 00.147, 00.148, 00.149, 00.172; *U.V. Makhija* & *G.S. Chitale*, 04.395; Mahadevgad, *N. Verma*, 04.380; Ajra, *B.C. Behera* & *N. Verma*, 04.332, 04.410: AMH

Figures 1–5 1. Vertical section of ascocarp *D. excipuloconvergentum* (Bar = 100 µm), 2-3. *D. excipuloconvergentum* ascospores Bar =50 µm, Habit. 4. *D. albocinerascens.* (Holotype) 5. *D. albovirescens* (Holotype). Bar = 1 mm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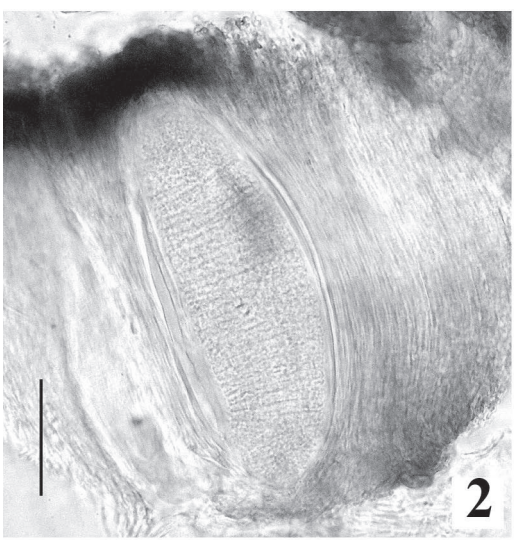
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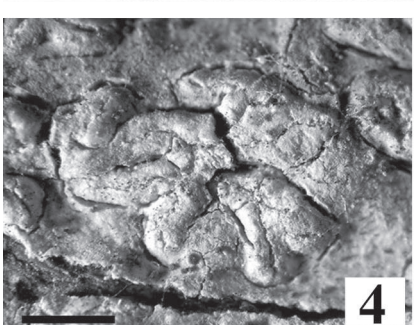
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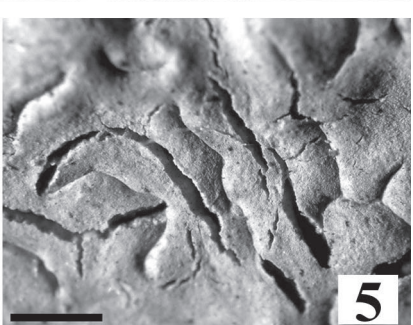
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Remarks—*Diorygma excipuloconvergentum* closely resembles *D. megasporum* but differs in producing norstictic, salazinic, cryptostictic and methylstictic acids in contrast to *D. megasporum* which has constictic, cryptostictic, and stictic acids. Indian specimens of *D. megasporum* has slightly smaller ascospores of 85–197 × 29–71 µm compared to 147–273 × 34–67 µm in *D. excipuloconvergentum*.

Diorygma excipuloconvergentum resembles the new species *D. megistosporum* (described here in that both species have 1–4 spored asci and large ascospores but *D. megistosporum* differs in producing only cryptostictic, norstictic, and stictic acids.

D. excipuloconvergentum is one of the most predominant species of lichens in Maharashtra and has been collected from dry deciduous and semi-evergreen forests.

Diorygma megaspermum Makhija, Chitale & B.O. Sharma, **sp. nov**. Figure 7

MycoBank MB 513539

Similis Diorygma megasporum, *sed ascosporis majoribus et acida consalazinicum, constictum, cryptostictum et stictum continens differt.*

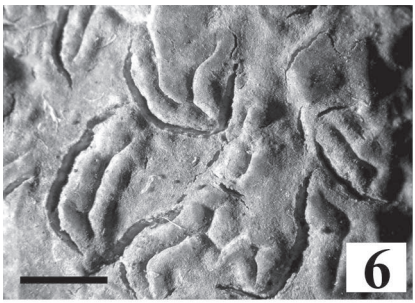
Etymology: From the Latin *mega*, large and *spermus*, seed; a reference to large ascospores.

Holotypus—India, Maharashtra, Sindhudurg District, Ajra to Amboli Road, 7.12.1974, *P.G. Patwardhan & A.V. Prabhu*, 74.2255: AMH.

Thallus crustose, corticolous, epiphloeodal, continuous, smooth, greenish white; pseudocortex invisible; black hypothallus present. Ascocarps lirelline, 0.5–9 mm long and 0.1–0.25 mm broad, simple, appearing like a dotted line, to rarely branched, immersed to slightly emergent, flexuous, scattered, concolorous with the thallus, tapering acute apices; thalline margin paler than the thallus or white, raised, often quite rugose, entire, studded with crystals, encircling exciple; disc narrow, pruinose; exciple poorly developed, convergent, 2–6-striate, blackish brown at apices and dark brown laterally, present at base, covered by a thick thalline margin up to the top; epihymenium dark blackish brown, 29–42 µm thick; hymenium hyaline, not inspersed, 113–155 µm tall, lateral and upper part KI+ blue; paraphyses branched, long, thin, septate, thickened, branched and interwoven at apices; asci 1-spored. Ascospores hyaline, muriform, without gelatinous sheath, ovoid, oblong, peripheral and central spore locules of equal size, 231–244 × 59–76 µm, I+ violet.

Chemistry—Consalazinic, constictic, cryptostictic, and stictic acids (major).

Figures 6–12 Habit.6. *D. excipuloconvergentum*. (Holotype) 7. *D. megaspermum* (Holotype). 8. *D. megasporum*. 9. *D. megistosporum*. (Holotype) 10. *D. "microsporum."* 11. *D. panchganiense*. (Holotype) 12. *D." patwardhanii."* Bar = 1 mm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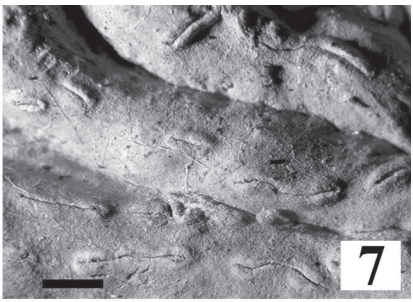
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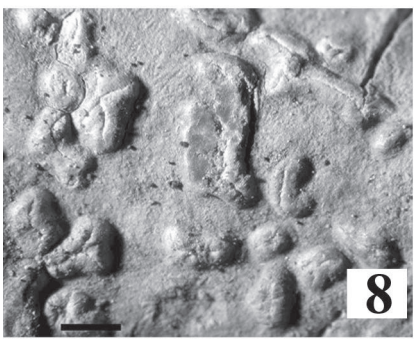
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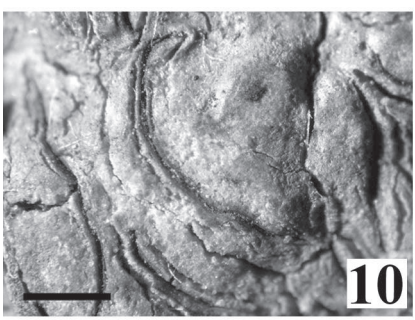
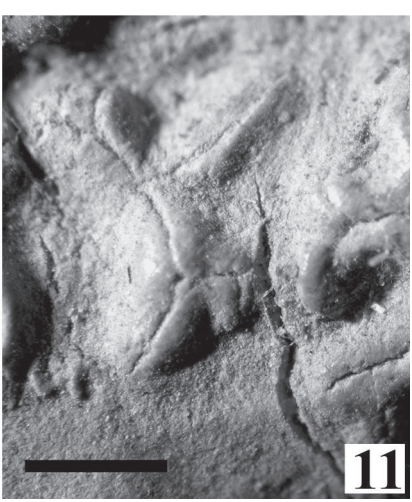

10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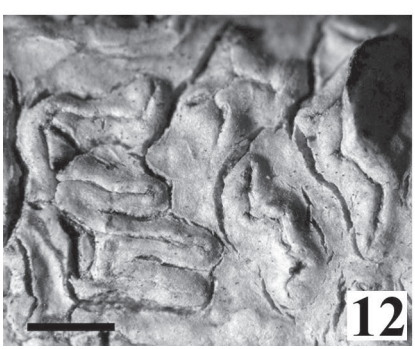
12

Additional specimen examined—**Maharashtra**, **Satara District**, Lingmala, Mahabaleshwar, *B.A. Adawadkar*, 04.8: AMH

Remarks— The new species *Diorygma megaspermum* is comparable to the new species *D. excipuloconvergentum* as both have large ascospores but *D. megaspermum* can be distinguished from the latter species on the basis of the chemistry. *D. megaspermum* has consalazinic, constictic, cryptostictic, and stictic acids while *D. excipuloconvergentum* has constictic, cryptostictic, methylstictic, norstictic, and salazinic acids in its thallus.

Diorygma megaspermum is some what similar to *D. megasporum*, however, differs in having large ascospores and lichen substances.

This species has been collected in semi-evergreen forests near a waterfall, where a few elements of primary forests are still present.

Diorygma megistosporum Makhija, Chitale & B.O. Sharma, **sp. nov**. Figure 9
MycoBank MB 513540

Similis Diorygma megasporum, *sed ascosporis majoribus et acida cryptosticticum, norsticticum et sticticum continens differt.*

Etymology: From the Latin *megisto* very large, and *sporum*, ascospores; a reference to very large ascospores.

Holotypus—India, Maharashtra, Pune District, Bhimashankar, 10.10.1970, *P.G. Patwardhan & P.D. Badhe*, 70.59: AMH.

Thallus crustose, corticolous, epiphloeodal, continuous, smooth to cracked, glaucous, whitish to greenish gray, thin, epruinose, pseudocortex invisible, hypothallus black. Ascocarps lirelline, 1–4 mm long and 0.1–0.3 mm broad, simple to rarely branched, flush with the thallus, rarely somewhat raised, paler than the thallus, whitish, or concolorous with the thallus, with acute or more or less rounded apices; thalline margin mealy entire, studded with crystals, encircling exciple; disc narrow, concealed, slit like or broader, blackish brown to black, white pruinose when open; exciple poorly developed, 3–4 indistinct striation, blackish brown at apices, present at the base, pale yellow to almost hyaline, apically convergent, covered by a thick thalline margin up to the top; epihymenium blackish brown, distinctly developed, 21–29 µm thick. hymenium hyaline, not inspersed, 143–201 µm tall, lateral and upper part KI+ blue; paraphyses profusely branched, long, thin, septate, thickened, interwoven at apices; asci 1–4-spored. Ascospores hyaline, muriform, fusiform-oblong, without gelatinous sheath, peripheral and central spore locules of equal size, 151–294 × 38–63(–84) µm, I+ violet.

Chemistry—Cryptostictic, norstictic, and stictic acids present.

Additional specimens examined—**Maharashtra, Kolhapur District**, Panhala, *P.G. Patwardhan* & *C.R. Kulkarni*, 74.1103. **Pune District**, Bhimashankar, *P.G. Patwardhan* & *P.D. Badhe*, 70.26, 70.54; *P.G. Patwardhan* & *P.D. Badhe*, 70.62; Khandala, *C.R. Kulkarni*, 73.205. **Satara District**, Mahabaleshwar, Lodwick Point, *P.D. Badhe*, 72.21; *A.V. Prabhu*

& *M.B. Nagarkar*, 74.1841, 74.1847; Dhobi fall, *M.B. Nagarkar*, 73.2927; Pratapgad, *C.R. Kulkarni*, 73.2945, 73.2949; Lingmala Water Fall, *V.D. Vartak*, L 129: AMH

Remarks—*Diorygma megistosporum* stands distinct among all the known species of *Diorygma* by virtue of its very large ascospores of 151–294 × 38–63(–84) µm.

Diorygma megistosporum is somewhat similar to *D. megasporum*, in ascocarp morphology as both have poorly developed convergent exciples with lateral brownish striations and thick blackish-brown epihymenium but the latter species has much smaller ascospores of 85–197 × 29–71 µm and has constictic, cryptostictic, and stictic acids in specimens at hand.

Diorygma panchganiense Makhija, Chitale & B.O. Sharma, **sp. nov.** Figure 11

MycoBank MB 513541

Similis Diorygma inaequale*, sed excipulum convergentum differt.*

Etymology: From the Latin *ensis*, place of origin; and place Panchgani, the type locality.

Holotypus—India, Maharashtra, Satara District, Panchgani, Tata Holiday Home, 29.9.2003, *U.V. Makhija & B.C. Behera*, 03.371: AMH.

Thallus crustose, corticolous, grayish, epiphloeodal, continuous, smooth to rough, finely cracked, pseudocortex invisible, hypothallus distinctly black. Ascocarps lirelline, 1–2 mm long and 0.5–1.3 mm broad, simple, semi-emergent, straight or curved, concolorous with the thallus; thalline margin raised, concolorous or paler than the thallus, entire, studded with crystals, encircling exciple; disc narrow, when open pruinose; exciple poorly developed, 2–3 striate, present at the base, thin, pale brown laterally, blackish brown at apices, convergent; epihymenium dark blackish brown to almost black, 15–20 µm thick, covered by fine pruina; hymenium hyaline, not inspersed, 126–200 µm tall, KI+ blue; paraphyses branched, long, thin, thickened, reticulately interwoven, compact at apices, forming the epihymenium; asci 1–2-spored. Ascospores hyaline, muriform, ellipsoid, peripheral and central spore locules of equal size, 75–99 × 24–30 µm, I+ violet.

Chemistry—Norstictic, salazinic, and methylstictic acids present.

Additional specimens examined—**Maharashtra, Satara District,** Panchgani, Tata Holiday Home, *U.V. Makhija* & *B.C. Behera*, 03.367, 03.368, 03.370, 03.372, 03.507: AMH

Remarks—*Diorygma panchganiense* differs from the closely related *D. albocinerascens* by the larger ascospores (135–150 × 12–27 µm) in *D. albocinerascens.*

D. inaequale, having norstictic and salazinic acids and more or less similar ascospore range, can easily be differentiated from the present new species especially by the divergent exciple in that species.

Other species

Diorygma megasporum Kalb, Staiger & Elix, Symb. Bot. Upsal. 34(1): 160 (2004).

Figure 8

Remarks—This species was described and recorded from the states of Maharashtra, and Sikkim in India by Kalb et al. (2004) who cited three specimens; the species is however, more widely distributed as shown by the specimens listed below. These specimens differ slightly in chemistry from *D. megasporum* and contain constictic, cryptostictic, and stictic acids as major compounds whereas Kalb et al. (2004) reported the presence of constictic, stictic, and α-acetylconstictic acids as major compounds. In the specimens below, the ascospores are 85–197 × 29–71 µm compared to 80–170(–220) × 21–55 µm reported by Kalb et al. (2004) We do not think that these differences are significant and therefore they are placed in *D. megasporum*.

A detailed description of *D. megasporum* is given by Kalb et al. (2004).

Additional specimens examined—**Maharashtra, Kolhapur District**, Amba, *C.R. Kulkarni* & *A.V. Prabhu*, 74.1245, 74.1246, 74.1247, 74.1247b, 74.1248, 74.1252, 74.1253, 74.1257, 74.1260, 74.1264, 74.1265, 74.1266, 74.1268, 74.1270, 74.1271, 74.1273, 74.1274, 74.1275, 74.1276, 74.1277, 74.1280, 74.1281, 74.1328, 74.1330, 74.1332, 74.1334, 74.1338, 74.1339a, 74.1345; Panhala, *P.G. Patwardhan* & *C.R. Kulkarni*, 74.1058, 74.1072, 74.1118; *P.G. Patwardhan* & *A.V. Prabhu*, 74.1108; *U.V. Makhija* & *K.R. Randive*, 00.382, 00.383, 00.388, 00393, 00.482, 00.484; Vishalgad-Amba-Gajapur Road, *A.V. Prabhu* & *M.B. Nagarkar*, 74.2162, 74.2188, 74.2200. **Pune District**, Khandala, Boma hills, *C.R. Kulkarni* & *M.B. Nagarkar*, 74.636, 74.643, 74.648. **Raigad District**, Karnala, *M.B. Nagarkar* & *A.V. Prabhu*, 74.568, 74.589, 74.601; Warandha, Bhor to Mahad, *M.B. Nagarkar* & *A.V. Prabhu*, 74.1939, 74.1940, 74.1954, 74.1964. **Ratnagiri District**, Nerur, *P.G. Patwardhan*, 75.441; Dabhole Ghat, *M.B. Nagarkar* & *A.V. Prabhu*, 74.2039, 74.2040a; Nivali village-Chiplun, *P.G. Patwardhan*, *M.B. Nagarkar* & *C.R. Kulkarni*, 74.2065, 74.2104, 74.2120, 74.2126, 74.2127, 74.2128, 74.2131, 74.2134, 74.2135, 74.2137, 74.2138, 74.2140, 74.2143, 74.2146; *G.S. Chitale*, 02.272, 02.273a; Ganpatipule, *C.R. Kulkarni*, 74.2046, 74.2080; Modke Agar, *G.S. Chitale*, 07.15. **Satara District**, Panchgani, *A.V. Bhosale*, 01.53. **Sindhudurg District**, Amboli, *C.R. Kulkarni* & *A.V. Prabhu*, 74.1395, 74.1400, 74.1426, 74.1652, 74.1653, 74.2243, 74.2247; *U.V. Makhija* & *B.A. Adawadkar*, 00.166, 00.171, 00.173; Radhanagari-Phonda, *U.V. Makhija* & *K.R. Randive*, 00.273; Vaibhavwadi, *B.A. Adawadkar* & *K.R. Randive*, 00.371, 00.374: AMH

***Diorygma "microsporum"* ad int.** Figure 10

Thallus crustose, corticolous, glaucous green, epiphloeodal, continuous, smooth to cracked, unevenly thickened, pseudocortex invisible, black hypothallus present. Ascocarps lirelline, 3–7 mm long and 0.1–0.25 mm broad, simple to branched, immersed to emergent, irregularly curved, wavy, concolorous with the thallus, tapering acute apices; thalline margin entire, concolorous with the thallus, studded with crystals, encircling exciple; disc narrow, reddish brown to blackish brown, when open pruinose; exciple poorly

developed, 2–5 striate, orange brown, present at base, carbonized at apices, convergent, covered by a thick thalline margin up to the top; epihymenium brownish black, made of interwoven apices of paraphyses tips; hymenium hyaline, not inspersed, 80–92 µm tall, lateral and upper part KI+ blue; paraphyses branched, long, thin, septate, thickened, branched at apices and interwoven; asci 8-spored. Ascospores hyaline, muriform, without gelatinous sheath, ovate, oblong, lumina lenticular, peripheral and central spore locules of equal size, 46–63 × 17–25 µm, I+ violet.

Chemistry—Stictic acid (major).

specimen examined—**Maharashtra, Satara District**, Mahabaleshwar, Pratapgad, *P. D. Badhe*, 72.24: AMH

Remarks—*Diorygma* "*microsporum*" is somewhat similar to *D. poiteaui* (Fée) Kalb et al. as both species have a convergent, striate exciple, 8-spored asci and small ascospores. However, they differ in chemistry. *D.* "*microsporum*" produces only stictic acid while *D. poiteaui* produces hypostictic and hypoconstictic acids as major compounds.

Since we have only a single, scanty specimen at hand it would be premature to describe the species as new. Therefore, it has not been formally described as a new species.

***Diorygma* "*patwardhanii*" ad int.** Figure 12

Thallus crustose, corticolous, grayish white, epiphloeodal, continuous, smooth to rough, deeply cracked and appearing areolate, pseudocortex invisible, hypothallus black. Ascocarps concolorous with the thallus, lirelline, 1–1.5 mm long and 0.2–0.5 mm broad, simple to branched, grouped, immersed, flush with the thallus; thalline margin raised, concolorous or paler than the thallus, entire, studded with crystals, encircling exciple; disc concolorous with the thallus, narrow, pruinose; exciple hyaline, poorly developed, 2–3 striate, present at the base, thin, pale brown laterally, blackish brown at apices, convergent; epihymenium dark blackish brown, 10–20 µm thick; hymenium hyaline, 105–125 µm tall, KI+ blue; paraphyses branched, long, thin, thickened, interwoven, compact at apices; asci 1-spored. Ascospores hyaline, muriform, ellipsoidal, peripheral and central spore locules of equal size, 57–96 × 24–36 µm, I+ violet.

Chemistry—Consalazinic, constictic, cryptostictic, and stictic acids (major) and hypostictic and norstictic acids (minor).

specimens examined—**Maharashtra, Ratnagiri District**, Chiplun, *G.S. Chitale*, 04.87. **Satara District**, Mahabaleshwar, Lingmala, *B.A. Adawadkar*, 04.13: AMH

Remarks—*Diorygma* "*patwardhanii*" is distinguished by 1-spored asci and the presence of consalazinic, constictic, cryptostictic and stictic acids. The species

resembles *D. albovirescens*, having ascospores of similar size but *D. albovirescens* has 4–8-spored asci and has only constictic, cryptostictic, and stictic acids.

Although we have two specimens from two different localities, both of them are too scanty to be designated as a type specimen. Therefore they have not been formally recorded as a new species.

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